

facilities operating with inflammable/ explosive materials, transportation tunnels, private homes, apartment and office complexes, and all other enclosed environments that require the prevention and suppression fire hazards. More information will be provided on the Internet at: [www.firepass.com](http://www.firepass.com).

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## CLAIMS

1. A system for providing breathable fire-preventive and fire-suppressive atmosphere in enclosed human-occupied spaces, said system comprising:
  - 10 an enclosing structure having an internal environment therein containing a gas mixture which is lower in oxygen content than air outside said structure, and an entry communicating with said internal environment;
  - 15 an oxygen-extraction device having an inlet taking in an intake gas mixture and first and second outlets, said first outlet transmitting a first gas mixture having a higher oxygen content than the intake gas mixture and said second outlet transmitting a second gas mixture having a lower oxygen content than the intake gas mixture;
  - 20 said second outlet communicating with said internal environment and transmitting said second mixture into said internal environment so that said second mixture mixes with the atmosphere in said internal environment;
  - 25 said first outlet transmitting said first mixture to a location where it does not mix with said atmosphere in said internal environment;
  - 30 said internal environment selectively communicating with the outside atmosphere and emitting excessive internal gas mixture into the outside atmosphere;
  - said intake gas mixture being ambient air taken in from the external atmosphere outside said internal environment.

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## CLAIMS

1. A system for providing breathable fire-preventive and fire-suppressive atmosphere in enclosed human-occupied spaces, said system comprising:
  - 10 an enclosing structure having an internal environment therein containing a gas mixture which is lower in oxygen content than air outside said structure, and an entry communicating with said internal environment;
  - 15 an oxygen-extraction device having an inlet taking in an intake gas mixture and first and second outlets, said first outlet transmitting a first gas mixture having a higher oxygen content than the intake gas mixture and said second outlet transmitting a second gas mixture having a lower oxygen content than the intake gas mixture;
  - 20 said second outlet communicating with said internal environment and transmitting said second mixture into said internal environment so that said second mixture mixes with the atmosphere in said internal environment;
  - 25 said first outlet transmitting said first mixture to a location where it does not mix with said atmosphere in said internal environment;
  - 30 said internal environment selectively communicating with the outside atmosphere and emitting excessive internal gas mixture into the outside atmosphere;
- said intake gas mixture being ambient air taken in from the external atmosphere outside said internal environment.

2. The system according to claim 1 and

said atmosphere in the internal environment being breathable fire-extinguishing gas

5 composition having oxygen content ranging from 10% to 17%.

3. The system according to claim 1 and

said oxygen-extraction device employing molecular-sieve adsorption technology in order to extract part of oxygen from said intake gas mixture.

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4. The system according to claim 1 and

said oxygen-extraction device employing oxygen-enrichment membrane or other air separation technology in order to extract part of oxygen from said intake gas mixture.

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5. The system according to claim 1 and

said second outlet additionally communicating with a high-pressure storage container for providing sufficient supply of said second gas mixture that can be released into said internal environment in order to suppress possible fire when said internal environment does not initially contain said second gas mixture.

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6. The system according to claim 1 and

said atmosphere being recycled by a split air-conditioning system in order to control the temperature and humidity inside said internal environment.

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7. The system according to claim 1 and

said enclosing structure with said internal environment therein being area selected from the group consisting of, but not limited to: rooms and enclosures for data processing and process control equipment, telecommunication switches and Internet servers; banks and financial institutions, museums, archives, libraries and art collections; dwellings and office buildings;

30 military and marine facilities; aircraft, space vehicles and space stations, marine and cargo

vessels; industrial processing and storage facilities operating with inflammable and explosive materials and compositions and other industrial and non-industrial facilities and objects that require fire safety in human-occupied environments.

- 5     8.     A breathable fire-extinguishing gas composition for continuous use in human-occupied environments as an artificial fire-preventive atmosphere, said gas composition comprising:
  - a mixture of nitrogen and oxygen at an atmospheric pressure being ambient or positive for location of use;
- 10    said mixture having oxygen content in a range above 12% but below 18%;
  - said mixture having nitrogen content above 82% but not exceeding 87.6%;
  - said mixture containing water vapors, carbon dioxide and other atmospheric gases in quantities that are acceptable for the breathing process;
  - said mixture having controllable temperature and humidity.
- 15    9.     The gas composition according to claim 8 and
  - said atmosphere receiving said composition constantly in amounts sufficient for ventilation of said environments in order to maintain breathing quality of the atmosphere;
  - said environments communicating with external atmosphere allowing excessive composition to exit into the outside atmosphere.
- 20    10.    The gas composition according to claim 8 and
  - said artificial atmosphere being created initially by introducing said mixture into a hermetic human-occupied object having life-support system maintaining said atmosphere at initial hypoxic settings;

said hermetic object being selected from a group comprising: an aircraft, space station or vehicle, underwater or underground facilities and vehicles, and other isolated human-occupied objects for living, working or transport;

5        said artificial atmosphere not communicating with the external atmosphere outside said hermetic object.

11.      A fire extinguishing gas agent and fire suppression system for use in enclosed and partially enclosed human-occupied spaces for fire suppression, said system and gas agent comprising:

10        a mixture of nitrogen, oxygen and other optional atmospheric gases contained in a high-pressure gas container;

              said mixture having oxygen content in a range from 0.01% to 16%,

              said mixture having nitrogen content ranging from 84% to 99.99%;

15        the amount of said gas agent detained in or released from said container being so calculated that when gas agent is released into said enclosed space, it provides a breathable fire-suppressive atmosphere inside said space having oxygen concentration in a range from 10% to 16%.

12.      The gas agent and system according to claim 11 and

              said gas container containing said agent at barometric pressure above 10 bar and releasing it when a signal from fire and smoke detecting equipment is received;

20        said container having a release valve initiated by an electro-explosive initiator actuated by said signal;

              said container having gas release nozzles connected directly or through optional gas distribution piping;

25        said nozzles having optional noise reducing device in order to reduce level of sound from gas release.

13. The system according to claim 11 and

said container being installed in combination with an oxygen-extraction device and receiving said gas agent from it, the agent being constantly maintained under selected barometric pressure by said device and/or intermediate compressor.

5 14. The system according to claim 11 and

said container being a free standing container having an individual fire and/or smoke detection system that initiates release of said gas agent in case of fire.

15. An automatic system for providing breathable fire-suppressive atmosphere for transportation and communication tunnels, industrial and non-industrial buildings and  
10 structures, said system comprising:

an interior space restricted by a wall structure having an entry and exit, and multiple isolating partitions defining selected segments of the interior space; said isolating partitions being selectively closable in case of fire so that when closed, the segments are substantially isolated from the outside environment;

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an oxygen-extraction device having an intake and first and second outlets, said device taking in ambient air through said intake and emitting a reduced-oxygen gas mixture, having a lower concentration of oxygen than ambient air, through said first outlet and enriched-oxygen gas mixture, having a greater concentration of oxygen than ambient air, through said  
20 second outlet;

a gas storage container having receiving conduit and distribution conduit and containing said reduced-oxygen gas mixture under higher than ambient barometric pressure, said receiving conduit being operatively associated with said first outlet and receiving said reduced-oxygen gas mixture after intermediate compression therefrom;

25 said distribution conduit communicating with said interior space so that the reduced-oxygen gas mixture is emitted in case of fire into one or multiple segments inside said interior space;

said second outlet communicating with the outside atmosphere and releasing said enriched oxygen mixture into the outside environment;

said reduced oxygen gas mixture having oxygen concentration below 16%;

5       said reduced oxygen gas mixture, being released inside selected segments of said interior space in case of fire and providing a breathable fire-suppressive composition with oxygen content preferably ranging from 12% to 16%;

said composition emitting from said interior space in amounts necessary to equalize atmospheric pressure inside said interior space with the outside atmospheric pressure.

10      16.     The system according to claim 15 and

said multiple isolating partitions being inflatable drop curtains normally kept deflated and folded in curtain holders installed under ceiling throughout the interior space;

15      said drop curtains being made of a clear and soft synthetic material in form of inflatable flaps so when inflated, they provide a sufficient obstruction for the draft or any substantial air movements into selected segments;

said curtains being inflated by a gas from a pyrotechnical device or container initiated by a signal from fire-detecting equipment.

17.     The system according to claim 15 and

20      said interior space being selected from the group comprising of rooms, houses and buildings, transportation tunnels and vehicles, underground and underwater facilities, marine vessels, aircraft, military installations and vehicles, and other human occupied objects.

25      18.     An automatic system for providing fire-preventive hypoxic atmosphere for transportation and communication tunnels, industrial and non-industrial buildings and structures, said system comprising:

an enclosed space comprising an entry, exit and a wall structure defining said enclosed space, said entry and exit having doors being selectively closable so that when closed, the enclosed space is substantially isolated from the outside environment;

5       a gas processing device having an intake and first and second outlets, said device taking in ambient air through said intake and emitting a reduced-oxygen gas mixture, having a lower concentration of oxygen than ambient air, through said first outlet and enriched-oxygen gas mixture, having a greater concentration of oxygen than ambient air, through said second outlet;

10      said first outlet communicating with a gas distribution piping having multiple discharge nozzles inside the enclosed space so that reduced oxygen gas mixture is transmitted into said enclosed space;

          said reduced oxygen gas mixture having oxygen content below 17% and above 12%;

15      said gas processing device comprising an air pump, receiving ambient air through the intake from the outside atmosphere, and an oxygen-extraction module receiving compressed air from the pump, said oxygen-extraction module having a reduced oxygen mixture conduit and an enriched oxygen mixture conduit;

20      said first outlet being operatively associated with said reduced oxygen mixture conduit and receiving said reduced oxygen gas mixture therefrom, said second outlet being operatively associated with said enriched oxygen mixture conduit and receiving said enriched oxygen gas mixture therefrom and releasing said mixture into the outside environment;

          said reduced oxygen gas mixture emitting from said enclosed space in amounts necessary to equalize atmospheric pressure inside said space with the outside atmospheric pressure.

19.     The system according to claim 18 and

25      said enclosed space being selected from the group comprising of computer rooms, houses and buildings, transportation and communication tunnels, nuclear power plants, underground and underwater facilities, marine vessels, and other non-hermetic human occupied objects.

20. An apparatus for providing breathable fire-extinguishing composition for human occupied environments, said apparatus comprising:

a compressor and an air separation device having an intake and first and second outlets, said

5 device taking in compressed air provided by said compressor through said intake and emitting a reduced-oxygen gas mixture having a lower concentration of oxygen than said gas mixture through said first outlet and enriched-oxygen gas mixture having a greater concentration of oxygen than said gas mixture through said second outlet;

said intake being connected to a distribution valve providing distribution of compressed air to  
10 multiple inlets communicating each with an individual separation container filled with a molecular sieve material that under pressure adsorbs nitrogen and water vapors, allowing enriched-oxygen gas mixture to pass through into a gas collecting tank communicating with said second outlet and being operatively associated with all said separation containers and receiving said enriched-oxygen gas mixture therefrom;

15 each said separation container being pressurized and depressurized in cycling manner and releasing during each depressurization cycle said reduced-oxygen gas mixture being delivered into said first outlet.

21. The apparatus according to claim 20 and

20 said second outlet having release valve allowing to keep said enriched-oxygen gas mixture being collected in said gas collecting tank under increased atmospheric pressure, so when any of said separation containers depressurizes, a portion of said enriched-oxygen gas mixture is released from said tank back into said container purging said molecular sieve material from remaining nitrogen and water.

22. The apparatus according to claim 20 and

25 said distribution valve being air distribution device selected from the group consisting of electrical, mechanical, air piloted and solenoid valves, both linear and rotary configuration, with actuators controlled by pressure, mechanical spring, motor and timer.

23. The apparatus according to claim 20 and

said distribution valve being mounted on manifold that is selectively communicating with said multiple separation containers and said first outlet, and selectively allowing periodic access of pressurized air inside said containers and exit of said reduced-oxygen gas mixture  
5 therefrom.

24. An automatic fire-extinguishing device for providing breathable fire-suppressive atmosphere inside an enclosed space, said device comprising:

a container having release valve and initiator communicating with a smoke/fire detection device, said container containing oxygen-reduced gas mixture under barometric pressure  
10 above 10 bar;

said initiator actuating the release valve when signal from said detection device is received;

the release valve releasing said oxygen-reduced gas mixture into said enclosed space and providing there said breathable fire-suppressive atmosphere with oxygen content ranging from 10 to 16%.

15 25. The invention according to claim 24 and

said oxygen-reduced gas mixture containing nitrogen in a range from 84% to 100% and may contain up to 16% of oxygen.

26. The invention according to claim 24 and

said gas mixture being mixture of nitrogen and carbon dioxide that may contain up to 16% of  
20 oxygen;

carbon dioxide content in said mixture being preferably below 30%.

27. A method and equipment for automatically maintaining a breathable fire-preventive composition on board a human-occupied hermetic object, said system comprising:

an initial introduction of said composition containing nitrogen into said hermetic object, said introduction provided by an oxygen-extraction apparatus directly or via an intermediate gas storage container, so when said composition completely replaces air inside said object and an internal atmosphere is created, the object being sealed and further air regeneration provided  
5 by an on-board life-support system;

said life-support system maintaining constant barometric pressure on board and regenerating said internal atmosphere by providing desired levels of oxygen, carbon dioxide and humidity, but not affecting the nitrogen content in any way;

10 said internal atmosphere containing a ballast, preventing oxygen content from rising above 16%;

said ballast being inert nitrogen being constantly present in said internal atmosphere in a range between 84% and 88%;

said atmosphere having oxygen concentration in a range from 12 to 16%.

15 28. The invention according to claim 27 and

said hermetic object being selected from a group comprising: an aircraft, space station or space vehicle, submarine, military vehicles and facilities, underwater or underground facilities, and other isolated human-occupied objects for living, working or transport.

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